Chapter 18

HANDLING FIRE DATA: THE FDMS

by

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INTRODUCTION

Prior to the coming of heat release rate tests, most fire tests had a relatively simple reporting format. Often, only the value of one particular variable was reported. It is true that with many of these traditional tests, the test report may not have been as simple as just one value being reported. Often, the test methods prescribed that a number of thermocouple channels, flame length distances, etc., be monitored and reported. Such reported data were, in fact, not useful nor used by the client or by the design professional. Instead, such ancillary measurements were only needed to document that the test laboratory carried out the test properly; if there were no improprieties noted, the additional information served no purpose.

With the coming of heat release rate concepts, all of the above is changed. Partly, this has happened because it was noted that the same combustion systems which are useful for measuring HRR are also ideal for making other measurements, such as smoke, soot, toxic gas species, or ignitability. This is true for both bench-scale and full-scale test methods. The result is that a test report from the Cone Calorimeter or from the room/corner test can contain a great deal of quantitative data. Also, unlike with the older tests, each of these bits of data can have design import. Thus, it is desirable that they be accessible in a reasonable way to the person who will be studying and predicting fires. Such a person will, these days, not only wish to make computations by hand, but also to execute complex computer fire models. These fire models require test data, and such data are difficult and time-consuming to enter by hand each time.

Thus, during the late 1980s it was realized by several laboratories, especially NIST and FRS, that two things were needed: (1) standards for exchange of fire data; and (2) a computer program which could perform database and graphics operations on fire test data from *any* fire test. After a number of years of planning and program development, the idea was brought to fruition as FDMS – the Fire Data Management System. In this Chapter, we will introduce the reader to the FDMS concepts and provide some illustrations which focus on HRR data.

THE BASIC CONCEPTS

It can be seen that data from HRR and other modern tests involve two different types of data, **vector** data, and **scalar** data. The scalar data are ones that, in a fire test, tell us, for instance, the thickness of the specimen, the temperature at which it was conditioned, or the trade name of the product tested. The vector data, by contrast, are a time series of either experimental measurements, such as oxygen concentration, or calculated data, such as HRR.

The storage of data

Each fire test normally includes both scalar and vector data, although some simple tests may have no vector data. Vector and scalar data must be stored and managed somewhat differently, since their usages differ. Since we will want to search for scalar data, it is appropriate to put the information into *database tables*. For example, we might wish to search for all the fire tests available to us where the specimen thickness was more than 25 mm and the peak heat release rate was less than 100 kW/m^2. Since we have required even in this simplest example that *(condition A must be true)* ***and*** *(condition B must be true)*, Boolean algebra operations must be implemented. It will later be seen that since there may be much redundant information in such a database, a *relational* database is preferred.

By contrast, searching for specific entries in vector data is rarely needed. Thus, for instance, one would not normally wish to find all the times during a particular test when the heat release rate was equal to 171 kW/m^2. Instead, with vector data the normal operation is plotting (including overlaying of plots), averaging, and, possibly, ratio-ing pairs of curves. For these types of operations, the simplest way to store the data is in a simple ASCII file, one each per test.

For each *type of fire test* currently encompassed by the FDMS, the majority of the scalar data are stored in what we call a 'main' table. The tables are stored within a computer in an internal data table format; this enables the needed search operations to be performed efficiently. The details of these formats will not be discussed here, since they are used only by the computer program itself. For data exchanges (described below), however, all of the data are converted to plain ASCII formats. The 'main' tables that have, thus far, been established, and the corresponding tests covered are:

- CONE for the Cone Calorimeter, ISO DIS 5660 [1]
- LIFT for the LIFT apparatus, ISO Draft Proposal DP 5658 [2]

- FURN for the Furniture Calorimeter, NORDTEST NT FIRE 032 [3]
- ROOM for the Room/corner test, ISO DP 9705 [4]
- BS476_7 for the British Standard 476 Part 7 Surface Spread of Flame test [5]
- SCHACHT for the German Brandschacht test, DIN 4102 Part 1 [6]
- EPIRAD for the French Épiradiateur test, NF P 92.501 [7].

Each test's data comprise one *record* in the pertinent main table. Most of the fields in these tables contain actual data. Some contain integer variables which are *related* to records in secondary tables. Secondary tables are tables which contain not the results of a particular fire test, but rather, some form of information which is pertinent to a large number of tests, or even to different test methods. The secondary tables are:

- ORGANISE for organizations sponsoring tests, performing tests, or producing products
- PERSONEL for individuals, such as test operator, test officer, etc.
- PRODUCT for products tested
- INSTRUM for instrument identifications, and
- CALIB for instrument calibrations
- INDEX which keeps track of what Main tables have been installed.

It can readily be seen that an entry in each of these secondary tables can be used by (i.e., related to) many different individual fire tests.

For a simple test which produces no vector output, the scalar information recorded in the data tables described above constitute all of the test information. Many fire tests, however, do produce extensive vector data outputs. For instance, one of the primary outputs of the Cone calorimeter is heat release rate readings, taken typically one every 5 s. Such vector data are stored as simple ASCII files, one each per test. Two types of files are, in general, present: *raw data* (example data: oxygen concentration measurements) and *reduced data* (example data: heat release rate values) files. The raw data files are used only for generating reduced data and are normally not interchanged with other organizations. The reduced data files contain information which can be interchanged. A file naming convention is established such that raw and reduced data files are clearly differentiated. The format of the vector data file is:

```
Header1
XX.XXX
-X.XXX
XX.XXX
-.XXXX
   .
   .
   .
```

Header2
X.XXXX
.XXXXX
.XXXXX
.XXXX
.
.
.
HeaderX
.
.
.

Each block, beginning with 'Header...', represents the information from either one *channel* of raw data or one *column* of reduced data. (We use the terms channel to denote the *vector*, or series of readings, corresponding to one physical instrument output; similarly, column is used to refer to a data vector in a somewhat more general context, when reference to hardware channels may not be appropriate). HeaderX is a multi-line header, which is slightly different for raw and for reduced data; the header contents are explained below. Each line after the header simply consists of numerical data, one reading per line. Each line is terminated by the <CR><LF> combination. The length of the file is not fixed; the operating system keeps track of the actual length.

Raw data

The order of storing the data blocks is not important, but will usually be in the order of increasing channel numbers. Raw data channels which were not assigned in a particular test are not stored for that test. One raw data channel (and the corresponding reduced data variable) must be allocated to the time readings.

The header consists of 5 lines which provide a definition, name, and calibration data for the instrument:

CHANNEL xx
SERIAL NAME
SHORT LABEL
LONG LABEL
CALIBRATION DATA

As an example, the following is a header pertinent to a pressure transducer:

CHANNEL 02
Pressure Transducer, MKS 223AH-A-10, SN 23128-1
PRES
Pressure drop across exhaust orifice plate
Volts Pa 0. 10. P1 0. 133.333

All the data after the header correspond to instrument readings. Each line represents a single instrument reading. The system can accommodate up to 4 significant figures, in either fixed-point or scientific notation. As many lines as necessary are included in the data file.

Reduced data

Again, the order for storing the columns is not significant. The header consists of four lines:

SERIAL NAME
SHORT LABEL
LONG LABEL
UNITS

SERIAL NAME and LONG LABEL are generally identical as for the raw data. The SHORT LABEL and UNITS are used in plotting and tabular presentations as heading or labels pertinent to this particular channel of vector data.

EXAMPLE DATA TABLE

As an example of the kinds of data included in a typical 'main' table record, we present the data table structure of 'CONE,' along with a brief description of the fields.

'Related File' gives information about the relations among the tables. 'R.F. Field#' identified the field number in one of the secondary tables. The explanations for the fields are given below, except for 'relational' data types. For those, the actual information is linked from the secondary tables, outlined above.

Field	Name	Type	Related File	R.F. Field#	Choice
0	DELETED	Logical			Y N
1	LABID	Relational	ORGANISE	1	
2	FILE	String$			
3	TESTDATE	Date			
4	PRIVATE	Mult. Ch.			
5	ADMIN	String$			
6	REPDATE	Date			
7	OPERATOR	Relational	PERSONEL	3	
8	OPERID	Relational	PERSONEL	1	
9	OFFICER	Relational	PERSONEL	3	
10	OFFID	Relational	PERSONEL	1	

(continued)

Field	Name	Type	Related File	R.F. Field#	Choice
11	SPONSOR	Relational	ORGANISE	3	
12	SPONID	Relational	ORGANISE	1	
13	SPONCONT	Relational	PERSONEL	3	
14	SPCONTID	Relational	PERSONEL	1	
15	PRODUCT1	Relational	PRODUCT	3	
16	PRODID1	Relational	PRODUCT	1	
17	PRODUCT2	Relational	PRODUCT	3	
18	PRODID2	Relational	PRODUCT	1	
19	INSTRUM	Relational	INSTRUM	1	
20	FLUX	Single!			
21	ORIENT	Logical			H V
22	PILOT	Logical			Y N
23	AREA	Single!			
24	THICK	Single!			
25	C	Single!			
26	E	Single!			
27	GRID	Logical			Y N
28	FRAME	Logical			Y N
29	ASCARITE	Logical			Y N
30	OXYGEN	Single!			
31	RHCOND	Single!			
32	TEMPCOND	Single!			
33	RHTEST	Single!			
34	TEMPTEST	Single!			
35	SCANS	Integer%			
36	INTERVAL	Integer%			
37	COMMENT1	String$			
38	COMMENT2	String$			
39	COMMENT3	String$			
40	COMMENT4	String$			
41	COMMENT5	String$			
42	MASSI	Single!			
43	MASSF	Single!			
44	TIGN	Integer%			
45	FLAMEOUT	Integer%			
46	MAXTIME	Integer%			
47	MAXQDOT	Single!			
48	MAXMDOT	Single!			
49	MAXSIGMA	Single!			
50	AVGQDOT	Single!			
51	AVGMDOT	Single!			
52	AVGHC	Single!			
53	AVGSIGMA	Single!			
54	AVGCO2	Single!			
55	AVGCO	Single!			
56	AVGH2O	Single!			
57	QDOT60	Single!			

Field	Name	Type	Related File	R.F. Field#	Choice
58	MDOT60	Single!			
59	HC60	Single!			
60	SIGMA60	Single!			
61	CO260	Single!			
62	CO60	Single!			
63	H2O60	Single!			
64	QDOT180	Single!			
65	MDOT180	Single!			
66	HC180	Single!			
67	SIGMA180	Single!			
68	CO2180	Single!			
69	CO180	Single!			
70	H2O180	Single!			
71	QDOT300	Single!			
72	MDOT300	Single!			
73	HC300	Single!			
74	SIGMA300	Single!			
75	CO2300	Single!			
76	CO300	Single!			
77	H2O300	Single!			
78	SOOT	Single!			
79	HCL	Single!			
80	HCN	Single!			
81	HBR	Single!			
82	HF	Single!			
83	USER1	String$			
84	USER2	String$			
85	USER3	String$			
86	USER4	Single!			
87	USER5	Single!			
88	USER6	Single!			
89	ZNUMBER	LongInteger			
90	VERSION	Integer%			
91	TEST	Integer%			

The explanations of the fields are as follows:

DELETED This field is used by the database system for record deletion purposes.

BID Is an integer number referring to the first field in the secondary table ORGANISE. This field is intended to hold the I.D. number of the laboratory where the test was done.

FILE This field is reserved for a laboratory-specific identification of the test series to which the test conducted belongs. This is typically the way to refer to the sponsorship of a test. In addition to 'File,' some laboratories call this information 'Test Code,' 'Job Number,' 'Test Ref.,' or some such similar appellation.

STDATE This is the date that the original test was run.

PRIVATE The PRIVATE field allows a laboratory to define the allowed level of access to the test results to other organisations within the database. As a multiple choice field, three options are available: 1) Freely allow the data to be exported without any changes in the data. 2) Purge the test of any information which would identify the manufacturer from the test before export. Or, 3) Do not allow export of the data under any circumstances.

MIN This field is intended to hold a laboratory specific code which might be used to store some internal admin information such as a Cost Centre code or invoice number.

REPDATE This is the date that the test was reported.

OPERATOR This field refers to the name field in the secondary table PERSONEL and it is used to store the name of the person who performed the test. The unique I.D. code of their record within PERSONEL is held in the following field, OPERID.

OFFICER This field also refers to the name field in the secondary table PERSONEL but here it is used to record the name of the laboratory officer responsible for the test. The unique I.D. code of their record within PERSONEL is held in the following field, OFFID.

SPONSOR This is the name of the test sponsor, which is actually held in the third field of the secondary table ORGANISE. This table holds information about organisations which includes all bodies be they sponsors, producers or laboratories. The following field SPONID holds the sponsors I.D. number.

SPONCONT This is the name of a person who is the contact at the sponsoring organisation. This name is actually held in the secondary table PERSONEL. The following field SPCONTID holds the unique I.D. No. of their record in the PERSONEL table.

PRODUCT1 Is a name cross referenced to the first field in the secondary table PRODUCT. This is the main product of which the sample consists. For instance for a particular foam/fabric combination of upholstered furniture, this could be the foam. The following field PROD1ID holds the unique I.D. number of this product within the PRODUCT table.

PRODUCT2 Is a name cross referenced to the first field in the secondary table PRODUCT. This is the secondary product of which the sample consists. For instance for a particular foam/fabric combination of upholstered furniture, this could be the fabric. The following field PROD2ID holds the unique I.D. number of this product within the PRODUCT table.

INSTRUM Laboratories may have more than one of a given type of fire test apparatus. This field is = 1 for the first unit = 2 for the second, etc.

FLUX Flux (kW/m^2).

ORIENT Specimen orientation, horizontal or vertical.

PILOT Indicates whether ignition was piloted (spark) or not.

AREA Specimen area (m^2). The area under the specimen holder edge or the edge frame is *not* excluded.

THICK Specimen thickness (m).

C This is the orifice constant as determined from the CH_4 burner calibration.

E Oxygen consumption constant. A generic value for this is 13.1 KJ/gO_2. If the composition of the fuel is known (CH_4, PMMA, ...) a more exact value can be used. At run time, the data acquisition program lets the operator specify the value to use from a menu. For instance, for PMMA, this value would be 12.98 kJ/gO_2 rather than 13.1 kJ/gO_2. The data reduction program uses the value in this field by default, however the user can still change it when the data reduction is being done.

GRID Denotes if the wire grid was used during testing.

FRAME Denotes if the edge frame was used during testing (meaningful only for horizontal orientations).

ASCARITE This fields tells whether the CO_2 was removed (using Ascarite, or equivalent means) from the sample before O_2 was measured or not. This information is needed to determine the proper algorithms to use when the raw data was being reduced during test import.

OXYGEN This is the nominal value of the oxygen concentration in the enclosure around the heater and sample. Its purpose is to enable quick searching of the database. For tests run at non-ambient oxygen concentration, the user may have installed a second oxygen meter to monitor the concentration of the inflow. Such data are then recorded in a vector data channel. For normal tests, the nominal value of 20.95% is specified.

RHCOND The relative humidity for specimen conditioning (%). This is important if, for example, the specimens were oven-dried at RH=0.

TEMPCOND The temperature (°C) for specimen conditioning.

RHTEST The relative humidity of the supply air for conducting the test (%). In the case of special, controlled atmospheres, this can be user selected.

TEMPTEST The temperature (°C) of the supply air for conducting the test.

SCANS This is the total number of scans made for this test. The value is not entered by the operator but by the computer program which is collecting the test data.

INTERVAL This is the interval in seconds between two consecutive scans.

COMMENT1..COMMENT5 The test comments together occupy a maximum of 5 lines of 60 characters each. They can be entered by the operator at any time before, during, or after a test. In some cases (e.g., second ignition) the comment is directly inserted by the software, not by the operator.

MASSI Specimen mass before the start of the test (g).

MASSF Specimen mass at the end of the test (g).

TIGN Time to ignition, defined as sustained flaming (s). This is the time of first ignition, even if more than one ignition/flameout have occurred. The subsequent ignitions are recorded with the comments.

FLAMEOUT Time to flameout (s). This is the time of the last flameout, if more than one ignition/flameout have occurred. The subsequent flameouts are recorded with the comments.

MAXTIME Time in seconds to the peak heat release rate (see MAXQDOT field).

MAXQDOT Peak heat release rate $\dot{q}''$ (kW/m^2). For some materials (e.g., charring materials), heat release rate curves have more than one peak. This field contains the peak which is the highest value for the whole test; it is an actual value and is not smoothed.

MAXMDOT Peak mass loss rate $\dot{m}''$ (g/s·m^2). The mass loss rate data is a numerically obtained multipoint estimate of the derivative of the mass loss. This value is smoothed, using the instructions provided in ISO DIS 5660.

MAXSIGMA Peak specific smoke extinction area σ_m (m^2/kg). As the raw σ_m records the actual turbulent fluctuations in the duct velocity, the instantaneous values of the extinction coefficient k have quite a bit of fluctuation. The computed specific extinction area, therefore makes use of a smoothing algorithm. Thus, this field contains not a turbulent instantaneous value, but a smoothed representation.

Overall and interval average values (fields 50-77) for heat release rate $\dot{q}''$ (kW/m^2), mass loss rate $\dot{m}''$ (g/s·m^2), effective heat of combustion Δh_c (kJ/g), specific smoke extinction area σ_m (m^2/kg), CO_2 yield (kg/kg), CO yield (kg/kg), and H_2O yield (kg/kg) are included in the database scalar record to facilitate searching of the database without searching the entire vector data file for each test.

SOOT This is the soot yield, i.e., the mass of soot deposited on the soot filter during the test divided by the mass of specimen loss during the test.

L, HCN, HBR, HF The yield of HCl, HCN, HBr, and HF, as determined by batch analysis, typically by ion chromatography. These are similar types of measurement as the SOOT field. These dimensionless quantities are determined using the raw data (grams of species), the ratio of mass flow rate through the solution to the main duct flow, and the mass of specimen loss during the test.

USER1..USER3 These fields contain user defined text data. This might, typically, be a variable name identifying a variable which would show up in the next group of (numeric) fields below. The data in these fields are site-specific and are not exported by the FDMS export module as they have no meaning in other implementations of the FDMS.

USER4..USER6 These fields contain user defined numeric data. For example, for a given test series the yield of NO_x may be one of the measurements. The user could attribute this field to the test-average NO_x yield. Again the scalar data in these fields is site-specific and is not exported.

ZNUMBER Is a unique test number which functions, essentially, as the "accession number" within a particular installation of FDMS. The Z-number is the mechanism by which the pertinent vector data DOS file is associated with the proper record in CONE. Simply, the name of the pertinent DOS file is ZNUMBER, plus the letter Z prefixed in front.

VERSION This contains the version number of FDMS, identifying the correct version of the data reduction routines that have been used. [Note that the data reduction routines are an integral part of the FDMS.]

TEST This is the (serial) test number assigned by the program collecting the test data. It is specific to the laboratory and to the instrument.

STANDARD FORMAT FOR DATA EXPORT AND IMPORT

Tests are exported and imported 'one-by-one.' That is to say, a single export file will consist of one record from a main (CONE, LIFT, etc.) table, more than one record from the secondary tables (ORGANISE, PERSONEL), and the complete set of vector data pertinent to that test.

Parts of an example file of the standard format used to export and import reduced data is given below. In essence, the exported (or imported) file is simply an ASCII representation of the database record and its associated secondary and vector data files. Each keyword (shown in bold here; their meaning and use are described in detail in the technical documentation to FDMS) is followed by the appropriate value for that keyword as a field in the primary table, secondary table, or vector data file. Thus, for the main table entry, note the correspondence to the CONE table described above.

EXAMPLE FILE FOR IMPORT/EXPORT

TABLE
CONE
FILE
34A-FG
SPONID
U1234567
SPONCONT
U2345678
LABID
U3456789
TESTDATE
12/14/87

.
. *Complete specification of the main table database record for this test*
.

TABLE
ORGANISE
ORGID
U123456
ORGAN
Sponsoring Company

.
. *Complete specification of the secondary table entries referenced directly or*
. *indirectly (through other secondary tables) in the database record for this test.*
.

VECTOR DATA
VARIABLE
Time
TIME
Time from sample insertion
Sec
0.0
5.0
.
.
.
VARIABLE
Load Cell, ATC 6005C06E1XX, SN 2851
MASS
Specimen mass
Grams
169.85
169.50
.
. *Complete set of vector data for this test (for reduced data files, this includes*
. *calculated results.*
.

THE FDMS COMPUTER PROGRAM

An effective system for managing fire test data must, in general, provide several types of functions. These include:

- accept raw data from a given test, convert to reduced data, and store the reduced data
- print out a standard test report on any test in the database
- delete a test from the database
- make a copy of the entire database (or a specified portion) to transmit to another installation
- perform searches, including Boolean functions, on the scalar variables stored in the database
- correct erroneous data in the database
- make interactive, overlaid screen plots and hard-copy graphs of the vector data
- provide for various specific-application-oriented query-and-report modules

Excluded from the Database System is the function of storing raw data. The main function of the System is to permit easy interchange of data by various users. It is not contemplated that raw data (which have no meaning by themselves) would need to be interchanged. Thus, the archiving of raw data from individual tests will be done purely as a local site operation.

The computer program which implements the above functions has been developed by the Fire Research Station and is available from them [8]. The operation of the FDMS is accomplished though a series of pulldown menus that provide easy access to all of the available functions of the system. Throughout the program, the user simply uses the cursor keys or a mouse to select the desired operation and be presented with another list of choices or a fill-in-the-blank menu to continue. At any point, an extensive online help system is available by simply pressing the Help key or clicking on the help icon with a mouse button. The help is context sensitive so that the help text which appears on the screen is keyed to the current operation.

Each of the above operations (and many more which are not specifically itemized here) are selectable by using a mouse or a cursor to 'pull down' a menu. In most cases, where additional information is needed, a further sub-menu or a dialogue box appears.

Hardware requirements

FDMS has been developed to run on only one family of computers – the IBM 80286/80386/80486 machines, and others which are fully compatible with these. Standards have also been adopted for video boards (VGA) and graphical output devices (Hewlett-Packard LaserJets). In addition physical standards were established for data exchange media: a 3½" floppy disk, for up to 1.44 MByte storage, and a 150 MByte cartridge tape for larger data exchanges. In all cases, only a single standard is prescribed, since it was realized that hardware prices are so low in comparison to programming costs that economics alone makes that decision for us.

Language versions

In the design of the FDMS it was been recognized that since it is expected to be used world-wide, the capability to operate in other languages is desirable. The program has been written so that the user may do two different operations related to language selection: (1) Configure the screen messages for the language of his choice. (2) Configure the language choice for the test report. These two options are not identical, of course, since an English-speaking user may desire to prepare a report for a French-speaking client. Language choices, as with most other selections, are implemented in a pulldown menu.

Data reduction algorithms

Data reduction is the process of performing needed computations to convert raw voltage readings into useful output variables, expressed in engineering units. Within the FDMS this is accomplished in the simplest way – the data reduction algorithms are incorporated as part of the routines for importing raw data. This means that any additional, intermediate programs for reducing data are not required; data reduction is just one of the logical steps to be followed in converting raw data into suitable entries in the database tables and files.

User extensions and additions

It will often happen that a given experiment, while conducted in a standard test apparatus, incorporated additional measurements for some exploratory purpose. These will generally consist of additional vector data channels. In other cases, no additional raw data will be gathered, but a special data reduction algorithm will need to be used. Traditionally, such tasks are handled by the user patching his version of the pertinent software. In terms of modern software design, this is undesirable. A user using patched software has no easy way of being updated when a new software release is issued. Thus, for FDMS a concept of user stub routines has been implemented. These allow users who do need to engage in such computer programming themselves to be presented a clean and simple interface for doing so, without there being a need for their understanding the operation of the program in its totality.

Customized report formats

FDMS comes already equipped with menu selections for issuing a standard printed report for each of the test types which are handled by FDMS. It is recognized, however, that often the user may wish to generate repetitive, but non-standard, reports. Such may be, for example, summary reports which analyze more than one type of test result per product, or combine results for more than one product in a single report. Unavoidably the user will need to do some programming to accomplish this. To help him in this task, standard calling sequences have been set up for these operations. By adhering to these calling sequences, the user will be able to install these customized report formats into the appropriate FDMS menu.

Quality of data

It must be emphasized that the FDMS formats and software are only intended to facilitate and standardize the exchange of data among users — this is **not** a mechanism for certifying or approving of data. It is, of course, essential that the quality of fire test data be sufficient for the intended task and that quality control procedures be present and be effective. FDMS, however, has not been designed as the tool for enforcing such data quality, but merely automating its storage and exchange. For the same reasons, the list of fire tests presented above are not intended to represent an 'approved' list, merely a list of those for which user demand has already been high.

FUTURE DEVELOPMENTS

Additional test types

While version 1.0 of FDMS does come with the capability to handle a number of different types of fire tests, nonetheless many of the less common tests which a user may wish have not been provided for. Thus, users may wish to develop the added capability to handle these test types. Once users identify such a need and prepare the appropriate tables and formats for these tests, they will then be incorporated into future versions of the software.

Relation to fire models

A very important aspect of the FDMS is that it is being developed as a tool for managing the fire test data inputs needed by various computer fire models. The integration of the FDMS with the fire models will be accomplished in several stages. In the first stage, input routines will be included in appropriate fire models to accept FDMS data in standard format. In a following stage, a tighter integration will be achieved, whereby the FDMS and the fire models will interact directly.

Graphics objects

The graphics within the initial implementation of FDMS provides for screen displays and plots only of the vector data from the tests. Additional graphics objects are sometimes of interest in connection with fire tests. For example, fire endurance test reports are customarily accompanied by drawings illustrating the construction details of the test object. It is envisioned that FDMS would eventually incorporate computer-generated construction drawings and similar graphics objects.

REFERENCES

1. Draft International Standard — Fire Tests — Reaction to Fire — Rate of Heat Release from Building Products (ISO DIS 5660). International Organization for Standardization, Geneva.
2. Fire Tests — Reaction to Fire — Surface Spread of Flame of Building Products — Vertical Specimen (ISO Draft Proposal DP 5658).
3. Upholstered Furniture: Burning Behaviour — Full Scale Test (NT FIRE 032). NORDTEST, Helsinki, Finland (1987).
4. Room Fire Test in Full Scale for Surface Products, ISO DIS 9705, International Organization for Standardization (1989).
5. Fire Tests on Building Materials : Reaction to Fire : Wall and Ceiling Linings. Part 3. Method of Measuring the Surface Spread of Flame. CEN/TC 127, to be issued.

6. Fire Tests on Building Materials and Structures : Reaction to Fire : Wall and Ceiling Linings. Part 2. Method for Assessing the Ignitability and Fire Propagation of Building Materials When Subjected to Thermal Irradiance (Épiradiateur). CEN/TC127, to be issued.
7. Fire Tests on Building Materials : Reaction to Fire : Wall and Ceiling Linings. Part 1. Method of Measuring Extent of Fire Damage (Brandschacht). CEN/TC127, to be issued.
8. The Fire Data Management System Software, package available for purchase from: Fire Research Station, Attn: S.A. Ames, Borehamwood, Herts WD6 2BL, England.